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the starry world and those of minute microscopic life. With improved instruments he is able to determine $\frac{1}{1000}$ degree of heat, to measure $\frac{1}{2000}$ line, to weigh $\frac{1}{10000}$ gramme. From coal-tar he prepares the most splendid colours; from shavings, brandy. He blasts rocks by means of gun-cotton; he builds machines which work better and more rapidly than human hands. But is not all science a struggle for liberty, a struggle with nature, in order to take from her what she would deny us, and to reveal to us what she has concealed from us. Whatever man knows, whatever he produces, whatever is noble in his breast, all this is merely acquired by labour; for the workings of nature are done in secret. The inert matter resists the formative power of man, and the necessities of the body always draw our senses downwards.

We have seen man in his struggle with the elements of nature, with animals and plants; but that enlightenment of our intellect by science struggling for truth, the representation of the beautiful which glorifies reality by art, and finally the moral force which subdues passion and rude instinct—these constitute the noblest victories of man over nature.

ON A HUMAN JAW FROM THE CAVE OF LA NAULETTE, NEAR DINANT, BELGIUM.

By C. CARTER BLAKE, Esq., F.G.S., Hon. Fellow of the Anthropological Society of London; Foreign Associate Anthropol. Soc. of Paris, Spain, and Moscow.

IN the autumn of 1866, the Council of the Anthropological Society confided to me a mission to the Wallon district of Belgium, to investigate in co-operation with our energetic Local Secretary at Brussels, Mr. John Jones, F.G.S., the recent excavations made by Dr. Edouard Dupont, of Dinant. My report on this subject, comprising minute details of the geology of prehistoric archæology of the district, was read before the Anthropological Society on Nov. 20th last, and has been passed for insertion in the *Memoirs* of the Society. As in the meanwhile great interest has been excited with reference to the jaw from La Naulette; and, as its more or less simious character has attracted great attention, I have, with the sanction of the Council and Publication Committee, been permitted to publish that portion of the memoir which relates to the Naulette jaw in the present form, without waiting for the publication of the next volume of *Memoirs*.

Jaw from the Trou de la Naulette.—The most interesting specimen which has been derived from the Belgian bone caves is the jaw which was found in the Trou de la Naulette, not far from the little village of Chaleux, and also on the south side of the river opposite the Trou de l'Hyène. Dr. Dupont has read before the Belgian Academy a description of this jaw in detail, which contains an account of the particular circumstances under which it was found. In a future memoir, a detailed section will be given of the geological conditions presented in the Trou de la Naulette, and of the strata found therein. It is for this reason that at present I do not offer a section, merely premising the fact that it was found in undisturbed lehm, or limon fluviatile, at a depth of about three metres and a-half from the surface, in a deposit of greyish yellow sandy clay, which also contained remains of *Elephas primigenius* and *Rhinoceros tichorhinus*. This sandy clay is perfectly stratified, and above the spot where the jaw was found are two layers of stalagmite, which alternate with other equally stratified beds of clay. With the jaw was also found a human ulna, and a fragment of reindeer bone, which apparently has been bored by some sharp instrument. Two human teeth were subsequently discovered, one of which fits the alveolus of the canine tooth in the jaw; and another, which was probably an upper incisor. Each of these teeth affords striking and remarkable characters unusual in mankind, and each will be described by M. Dupont at the proper time. I am most anxious not, by any premature publication, to deprive that accomplished observer and generous *savant* from the just honour due to him for his valuable researches.

The first character which strikes the observer is undoubtedly the very slight resemblance which it bears to the jaws found by M. Dupont in the Trou de Frontal; the second is the resemblance which it also bears to the jaw of the Australian. In the words of an anonymous writer (*Reader*, July 28, 1866):—

“Compared with the extremely ‘brachycephalic’ jaws which have been discovered in the caves of Arcis-sur-Aube, and from various prehistoric deposits in the south of France, this jaw represents the extreme term of a series, the other end of which is exhibited by the lowest members respectively of the Lapp and Australian races. By the quinquercinate mode of implantation of its third true molar, by the enormous size of the canines, by the absence of any chin, by the absence of genial tubercles, by the great symphyseal beak-shaped degree of prognathism which it exhibits, it affords characters which, though they may be present in different individuals of the lower races of man, have never hitherto been found united in any single specimen.”

These, therefore, are the apparent characters; and it behoves us to

inquire how far they are essentially indicative of peculiar racial type, or how far they are characters which naturally come within the limits of individual variation. To do this, the jaws accessible to me in the Museum of Natural History at Paris were carefully examined and measured. The comparison that follows represents the results afforded by the examination of more than three thousand human jaws, in which I was kindly assisted by the illustrious French anthropologist, M. Pruner Bey. The resemblance which prevails between it and certain typical "brachycephalic" jaws shall be first discussed.

The characters of the "brachycephalic" jaw* have been thoroughly worked out by my friend M. Pruner-Bey. He has placed at my disposal the principal conclusions to which he has arrived, and I am happy to say that in the main they accord very closely with those to which I have myself been led, while preparing materials for a memoir on "the form of the lower jaw in the Races of Men." This memoir I have not yet been able to lay before the Society.

M. Pruner-Bey well pointed out to me the characteristic forms which the jaw so frequently adopts amongst brachycephalic individuals. There are three several forms. One is exemplified in the jaw of a Croat in the collection of the Anthropological Society of London. Here the front of the jaw is produced forward in such a way that the mentum is almost quadrangular. The genial tubercles are large; and deep depressions extend immediately in front of the dentary foramen. I propose to call this the "eurygonic" type, from *εὐρυς* and *γωνία*.

The second form is presented in a Wendic skull also in our museum. In this type, which may be called "mesepicentric," from *μεσος*, *ἐπι*, and *κεντρον*, the mental process is much centrally elevated, a gentle ridge or elevation extending downwards from between the two central incisors to the chin; this elevation gradually becoming larger as it descends.

The third form is that which is presented by the jaws from Arcis-sur-Aube, and by that from the Trou de la Naulette. This type, in which the chin is not at all developed, may be called the "agonic" type, from *α*, privative, and *γωνία*. The mesepicentric form is frequently found in dolichocephalic skulls. The eurygonic and agonic, to my knowledge, never.

Amongst the largest series of brachycephalic skulls, we find these types of jaw widely spread over the whole area occupied by the nations who have been called *brachycephali prognathic*, by Retzius. M. Dupont has figured the most striking examples of the agonic type in his memoir, where it will be observed that the jaw from Arcis presents the essential characters afforded by the jaw from the Trou de la Naulette, although to a far less extent.

* This "Hibernism" must be permitted.

In a comparison of the jaw from the Naulette with typical human jaws, I propose to divide my remarks as follows:—1. Measurement; 2. Alveolar curve; 3. Dentition; 4. Symphysis; 5. Chin; 6. Conclusions.

In instituting a series of measurements of the Naulette jaw, I have thought it only necessary in the present case to give comparisons with a jaw from the Trou de Frontal (reindeer period) with a brachycephalic jaw from Hyères (closely resembling the celebrated Moulin-Quignon jaw), with three brachycephali of existing Eastern European races—a Croat, a Wend, and a (female) Masure, with an Australian jaw belonging to a debased individual of the tectocephalic type, with the jaw of a male English Northumbrian brachycephale from Alnmouth, and with the jaw of a recently living Englishman ("Celtic" type of M. Pruner-Bey), from Milcote, near Stratford-on-Avon. The following are the results.

Table of Measurements (Mandibular) in Millimètres

	Height of chin outside.	Ht. of jaw under first premolar.	Ht. of jaw under third molar.	Dist. of dental foramen from lower border.	Dist. of dental foramen from alveolar line.	Dist. of dental foramen from centre of chin.	Thickness of jaw at chin.
Trou de la Naulette	33	26	23	13	13	31	15*
— du frontal	28	25	23	13	12	37	12
From Hyères	29	30	25	15	18	30	11
Croat	27	26	23	13	14	28	14
Wend	28	27	22	11	14	27	15
Masure	28	21	22	12	13	23	13
Australian	30	29	27	15	17	34	14
Alnmouth	27	25	25	14	13	27	16
Stratford	36	34	28	15	19	31	14

* It must not be forgotten that there are no genial tubercles.

Table of Measurements (Dental) in Millimètres.

	Total length of incisors outside.	Total length of incisors inside.	Length of pre-molar outside.	Length of pre-molars inside.	Length of molars outside.	Length of molars inside.	Length of pre-molar 1.	Length of pre-molar 2.	Length of molar 1.	Length of molar 2.	Length of molar 3.	Breadth of molar 3.
Trou de la Naulette	22	17	18	14	34	30	7	9	10	12	14	7
— du frontal ...	19	17	14	12	—	—	8	6	11	11	—	—
From Hyères	18	16	12	12	—	—	8	6	11	10	—	—
Croat	18	17	13	13	27	27	7	7	—	9	10	—
Wend	19	17	13	12	31	29	7	6	12	10	9	8
Masure	21	17	13	12	—	—	6	—	9	10	—	—
Australian	20	17	14	13	36	33	7	7	12	11	11	9
Alnmouth	10	16	12	11	29	28	5	6	10	9	9	8
Stratford	17	16	11	10	30	29	5	5	10	9	8	8

The first character which strikes the observer is the perfect accord-

ance of the curve which the lower border of the jaw makes with the same curve in the jaw from the Trou de Frontal and the great dissimilarity which it presents with the curve of the Celtic jaw and of the Australian. This character alone, when distinctly conceived, would be entirely decisive against the hypothesis of the "pithecoïd" nature of the jaw ; inasmuch as not even in the young anthropoid ape, wherein the jaw presents a more equable curve than in the adult, does the curve of the lower border in the slightest way resemble that of the homologous structure in man.

Dentition. It is a source of great regret that when the jaw was discovered no teeth were in place. Since the discovery, however, an incisor and a canine tooth have been found, which present peculiar characters. As, however, M. Dupont has not yet described these, I forbear to publish any account thereof.

The characters of the dentition in the existing races of men have been well and thoroughly described, both in the "Odontography" of Professor Owen and in Dr. Webb's "Teeth in Man and the Anthropoid Apes." I shall cite from the latter work, which unfortunately is not in general circulation, a few passages, before proceeding to point out the characters afforded by the dentition, as evinced by the alveolar condition in the jaw from the Trou de la Naulette.

I first give the characters of the jaw in the leading types of anthropoid apes: "In the lower jaw, the three molar teeth of the gorilla are equal in size ; in the chimpanzee they are nearly equal, the first being only slightly larger than the last. The implantation of these teeth resembles that in the human subject, except in the fact that the two roots of the second and third are never found connate in the gorilla and chimpanzee."—(*Loc. cit.*, p. 34.)

"In man, on the contrary, this bifurcation is most apparent in the third molar. As in the upper jaw the last-named tooth (the third molar) is the smallest of the true grinders, each molar is implanted by an anterior and a posterior sub-compressed fang, which are grooved along their opposed sides. It is not uncommon to find these fangs more or less connate in the second and third teeth of the series."—(*Loc. cit.*, page 33.)

"It is usual in melanous races to find the third molar in both jaws relatively larger than in Europeans, and, as we have already noticed, the fangs are most commonly distinct."—(*Loc. cit.*, page 40.)

"Professor Owen has observed, that in the melanous varieties generally the true molars are of large size, and that the fangs of the wisdom and penultimate molars are not as a rule connate or conjoined. This he finds generally to obtain, although it is most remarkable and constant in the Australian variety. The truth of this observation is not for a moment to be disputed, albeit we meet with exceptions which prove it not to be a ground of specific distinction, and as such it is not advanced by Professor Owen himself. But in

these, the lowest races of Africa, we do not find the molar series attaining a remarkable size. In the skull of our female Bosjesman we have examined, the three molars present (the *dentes sapientiæ*, upper jaw, were not in place) were of moderate size; neither they nor the pre-molars differed from the usual standard.”—(*Loc. cit.*, page 39.)

“In the negro, the true molars are usually of large size, generally larger than in the European; the *dentes sapientiæ*, although smaller than the other molars, are, in the majority of instances, of greater relative and actual dimensions, and the fangs of the last-named teeth are usually distinct in both jaws.”—(*Loc. cit.*, page 41.)

“We have ascertained by measurement that the antero-posterior dimensions of the true molar series in the upper jaw in eighteen negro skulls, varied one inch one-and-a-half lines to one inch four lines, the former measurement being less than is frequently attained by the same series in the civilised races. A similar result has been elicited by the admeasurement of the true molar series in the lower jaw. To show how the dimensions of the grinding teeth vary even in individuals of the same stock, we may state that we have before us, at the time of writing, three lower jaws of Anglo-Saxons, for the possession of which we are indebted to an eminent archæologist, the late Secretary to the Society of Antiquaries. In one of these the fore and aft measurement of the true molar series is one inch one-and-a-half lines, in another one inch three-and-a-half lines, in the third one inch four lines. We have seen the last-named measurement exceeded in only one African jaw; in it the lower true molar teeth measured from before backwards one inch five lines.”—(*Loc. cit.*, page 42.)

Dr. Webb goes on to observe: “Dr. Lund, a Danish geologist, who professes to have discovered fossil human skeletons in the Brazilian bone caves, characterises the incisor teeth of the fossils as having the upper surface oval, and of longer antero-posterior than transverse diameter. On the supposition that he has not been mistaken as to the human character of the remains in question, it is most probable that he has fallen into a similar error with Blumenbach, in confounding the worn with the natural condition. Such a configuration of the unworn incisor teeth is not to be found in any known tribe of Indians: neither, as far as our information reaches, has it been discovered in any accredited skulls of extinct races.”—(Page 54.)

“The *dentes sapientiæ*, which of all human teeth are subject to the greatest variety, are usually in the Malayo-Polynesian of typical proportions; that is to say, they are considerably smaller than the penultimates. Differences in the complexity of their implantation are of constant occurrence. In many instances they are inserted by distinct fangs, whilst occasionally the fangs of the third molars may be found as connate as is most usual in the Celt and Saxon.”—(*Loc. cit.*, page 46.)

“In the skull of a native of Erromanga, an island of the western division of the New Hebrides, preserved in the Osteological Department of the British Museum, we observed that the fore and aft measurement of the lower molar series was only one inch one-and-a-

half lines, whilst in the upper jaw the same measurement was one inch one line."—(*Loc. cit.*, page 52.)

"The dimensions of the true molar series vary in Australian crania, not only in the length of the entire series, but in the breadth of the individual teeth. In twelve Australian skulls we found the antero-posterior measurement of the true molar series in the upper jaw to range from one inch two lines to one inch four lines; in five lower jaws we found the same series measuring from one inch two-and-a-half lines to one inch five lines in length."—(*Loc. cit.*, page 49.)

"Now in the West Coast African negro, the true molar series of the upper jaw occasionally attains the length of one inch four lines, that of the lower jaw one inch five lines, in both cases equalling the extreme longitudinal measurement in the Australian. In the skulls of an Affghan, a Hindoo, a New Zealander, an American Indian of the Chinook tribe, a Patagonian, an Indian of Tierra del Fuego, and in an early English skull, the fore and aft measurement of the same series in the upper jaw was one inch three lines respectively: in the lower jaw of the Affghan it was one inch four lines; and in the Chinook Indian mandible one inch four-and-a-half lines. It will be observed, that these measurements are all greater than the minimum noticed in the Australian. The greatest antero-posterior measurement of the true grinders we have noted, is in the lower jaw of an Englishman, of abnormal stature, in the Museum of the Royal College of Surgeons: it is one inch six lines."—(*Loc. cit.*, page 50.)

"The fore and aft measurement of the upper true molar series in the white races we have found to vary from one inch half line to one inch three lines; the lower, from one inch one-and-a-half lines to one inch four lines. The maximum in both cases has been obtained from crania of early inhabitants of this island. The greatest diminution of the third molars that has occurred to us has existed in modern English skulls. A complex implantation of the wisdom tooth is the exception; but as an exception it is not very rare."—(*Loc. cit.*, p. 56.)

Such being the characters presented in the principal races of men, I shall now proceed to describe the condition of the alveoli of the present jaw. The incisor teeth form an equable curve, which differentiate them strongly from the deep conically fanged canine. The socket of the first premolar, rounded and compressed from side to side, is nearly parallel to that of the canine; the socket of the second premolar is turned slightly outwards, especially in its posterior position. The first and second premolars both exhibit the normal European implantation by one fang; and the canine, so far as can be judged from the alveolar, exhibits the prevalence of the same law.

The first true molar has a squared socket, prominently and distinctly divided into two well marked fangs; the interval between which has been greater than customary in normal European lower jaws.

The second molar has also been implanted by two fangs, the an-

terior of which has perhaps shown a slight tendency to bifurcation. Its level in the alveoli is a little below that of the first molar, but there is every reason to believe that it was fully developed during life.

The third molar, the most remarkable of all, is much rounded in its posterior, and slightly angular at its anterior corners, forming outwardly, inwardly, and backwardly a quasi-circular arc. Traces are distinctly visible on the original specimen, as well as (though to a less extent) on the cast of the implantation of the tooth by three fangs into this alveolus. The internal side of the alveolus, on its anterior corner, exhibits a smoother surface, terrace-like in form, which extends around a part of its periphery. A similar condition has been noticed in several Australian jaws.

In a typical Australian jaw in the collection of the Anthropological Society, the implantation is functionally and definitely by two fangs, the anterior one having a tendency itself to bifurcate. In the other Australian skulls which I have seen, I have never yet seen any tendency to bifurcation.

The socket of the third molar, unlike its homologue in most Australian skulls, is much larger than that which contained the second molar; a similar condition is, however, presented in an Australian jaw in the British Museum. This character, however, is extremely unusual; and in this respect, as well as in the complex implantation of the third molar tooth, the jaw before us presents an exaggeration of the Australian type.

Turning to the symphysis, the first character which strikes the observer is the enormous deposit of bone, which, filling up the symphyseal cavity immediately above the fossa which contains the sublingual gland, has left a bony terrace, traces of which are to be observed on the internal face of the jaw, so far back as the first premolar tooth. In the young orang (*Simia Morio*) this shelf-like structure occupies the same space, and is bounded by the same limits. This, at first sight the most strikingly simious character in the jaw, has struck all the observers who have previously seen it. Careful and diligent comparisons with the jaws of Europeans, Australians, and Esquimaux, have failed to afford me examples of a similar case. Its great and apparent resemblance with the homologous structure in the jaw of orang may lead to conclusions which bear out the "pithecoïd" theory; but when we reflect that the character is purely adaptive, and that the relative and absolute great thickness of the jaw at its symphysis originates this shelf-like structure, which is solely caused by the great deposit of osseous matter around the site of the genial tubercles, a lesson of caution is impressed on us.

The mental prominence is not developed; in this respect according

with, though exaggerating the peculiarities of the jaw from Arcis sur Aube (also coeval with rhinoceros and hyæna). It will be exceedingly difficult to match this amongst any jaws either of the white or black races of man; at least, I have not yet been able to find a similar specimen. When the jaw rests upon its lower border, a vertical line let fall from the point between the two middle incisors touches the ground 4 mm. in front of the chin; in a well-formed European jaw, it is 12 mm. behind the chin; in an Australian jaw, it is 2 mm. behind it.

I now have to consider the variations, if any, afforded by the points for insertion of muscles on this jaw. It must always prove a source of extreme regret that the ascending ramus was broken away by some abrupt force, which has also shattered the dextral half of the jaw immediately behind the first premolar. On the left side the ascending ramus has been also broken away, but sufficient portion of it remains for us to say with certainty that the masseter muscle was not excessively marked on it. None of the muscles, in fact, have excessively pronounced points of insertion, a character which may lead to the inference that the individual was a female. This attributed character is further corroborated when we examine the close general resemblances which it presents to the jaw of the female *Masure* above measured. The external oblique line is not strongly marked. The mental foramen is situated in the centre of the point of attachment of the *depressor anguli oris*, instead of, as is most usual, being slightly above. In this character, as well as in the general obscuration of the external oblique line, the specimen accords more nearly with the Australian than with the European type. The insertions of the *levator menti* and *platysma myoides* do not exhibit any special characters. Turning to the internal surface of the jaw, the digastric muscle has left remarkably deep insertions, exceeding in character and depth those presented in any jaws I have yet examined. The tubercles for the attachment of the *genio-hyoideus* and *genio-hyo-glossus* muscles are absent. Their place is filled by an irregular elevation. Gray observes, "Sometimes the tubercles on each side are blended into one, or they all unite into an irregular eminence of bone, or nothing but an irregularity may be seen on the surface of the bone of this part" (page 62). The mylohyoid ridge is strongly marked; it is largest and thickest immediately above the digastric fossa. The mylohyoid groove has been normal; the mylohyoid ridge shelving strongly above it near the attachment of the *superior constrictor* muscle. The fossa for the submaxillary gland has not been deep.

Such, therefore, are the chief characters afforded by the above jaw. Many diverse opinions will probably be expressed respecting its affinity. Its undoubted resemblance to the jaw of a young ape I shall not ven-

ture to deny ; nevertheless, I shall not attempt to offer any theory respecting the mental or social status of the individual, or of his or her complexion, stature, or probable appearance. In the present state of the case, we have not all the materials before us. I have intentionally refrained from stating all the characters which some of the other remains present, as M. Dupont will adequately describe them elsewhere. At present I shall merely propound the following conclusions, based solely upon the evidence I have laid before you.

1. That the deposit of stratified *limon fluviatile* under stalagnite, in the Trou de la Naulette, was due to the action of slowly operating causes.

2. That the individual whose jaw was found therein was contemporary with the elephant and rhinoceros, whose remains are embedded under like conditions.

3. That some of the characters afforded by the jaw indicate a resemblance to jaws of the Slavonic peoples of Eastern Europe, as especially exemplified by the Masures and Wends.

4. That the above character affords a distinction between the remains found in the Trou de la Naulette and those found in the Trou de Frontal, which contained during the reindeer period individuals strongly resembling the Calmucks of the present day.

5. That some of the characters indicate a strong resemblance to, and exaggeration of, the characters afforded by the melanian races of men, and especially the Australian.

PHENOMENA OF THE HIGHER CIVILISATION

TRACEABLE TO A RUDIMENTAL ORIGIN AMONG SAVAGE TRIBES.

By EDWARD B. TYLOR, Esq., F.A.S.L., F.R.G.S.

MEN have so long felt an interest in the character and habits of their own kind, they have so long practically acknowledged that nothing human is alien to themselves, that we are rich in information as to savages and peoples whose condition lies between that of savages and our own. But the positive value of this information is only now of late years beginning to be apprehended. It is only of late that we have begun to see how much a knowledge of the lower races is capable of giving us besides a mass of entertaining details and quaint stories for our amusement, and beside the means of completing the picture of mankind by taking in both its higher and lower developments. We are beginning to see that over and above all this, the study of the lower races is capable of furnishing most important knowledge about